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 assigned)
U.S. Filing Date: concurrently) Examiner: not yet assigned
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International Application No:)
 PCT/AU2003/001331)
International Filing Date:)
 9 October 2003) Our Ref.: B-5682PCT 622598-3
For: "SECURITY DEVICE")
) Date: April 8, 2005

35 U.S.C. 119 CLAIM TO PRIORITY

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Attn: United States Designated/Elected Office (DO/EO/US)

Sir:

Prior PCT International Application No. PCT/AU2003/001331,
designating the U.S., claims foreign priority as follows:

<u>COUNTRY</u>	<u>FILING DATE</u>	<u>SERIAL NUMBER</u>
Australia	9 October 2002	2002951963

The certified copies have been filed in prior PCT International
Patent Application No. PCT/AU2003/001331.

Applicants hereby confirm that this claim for priority applies to
the above-identified U.S. International stage application.

Respectfully submitted,



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I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2002951963 for a patent by COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION as filed on 09 October 2002.



WITNESS my hand this
Twenty-second day of October 2003

J. Billingsley

JULIE BILLINGSLEY
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**PRIORITY
DOCUMENT**

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AUSTRALIA
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PROVISIONAL SPECIFICATION

Applicant:

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH
ORGANISATION

Invention Title:

METHOD OF COMBINING IMAGES

The invention is described in the following statement:

METHOD OF COMBINING IMAGES

Field of the Invention

5 The present invention relates to a method of combining a plurality of primary images into a secondary image, in such a manner that each of the primary images can subsequently be separately viewed through a mask by an observer. Embodiments of the invention have application
10 in the provision of security devices which can be used to verify the legitimacy of a document or instrument, for example, a polymer banknote. Other embodiments can be used to provide novelty items.

15 Background to the Invention

 In order to prevent unauthorised duplication or alteration of documents such as banknotes, security devices are often incorporated within banknotes as a
20 deterrent to copyists. The security devices are either designed to deter copying or to make copying apparent once copying occurs. Despite the wide variety of techniques which are available, there is always a need for further techniques which can be applied to provide a security
25 device.

Summary of the Invention

 Accordingly, the invention provides a method of
30 combining a plurality of primary images into a secondary image in such a manner that the primary images can subsequently be viewed by an observer, the method involves:

 providing a mask having a plurality of regularly
35 spaced viewing portions;

 providing a plurality of primary images having a plurality of image elements having the same spacing as the

viewing portions; and

overlaying the plurality of primary images to form a secondary image in which the image elements of the primary images do not overlap each other, in order that
5 each of the primary images may be separately viewed by altering the relative positions of at least two of the mask, the secondary image and the observer.

Herein, the term "primary image" is used to refer
10 to those images which are to be combined into the secondary image. The primary images may be derived from original images, for example, by applying the mask to original images in order to obtain a primary image in which the image elements have the same spacing as the
15 mask. The term "secondary image" is used to refer to the image containing the primary images irrespective of whether the secondary image has been subject to further modification after the primary images have been combined as may occur in some embodiments.

20

Where the mask is movable relative to a surface comprising the secondary image, each of the primary images may be individually viewed by moving the mask relative to the secondary image.

25

In one embodiment the mask may be provided on one side of a sheet of transparent material with the secondary image printed on the other side of the transparent material whereby the individual primary images may be
30 viewed by moving the observer and the sheet of transparent material relative to one another.

The image elements may be different or the same depending on the required effect.

35

The primary images may be related in order to provide an animation effect as successive images are

viewed.

Techniques may be used to disguise the presence of the primary images in the secondary image, particularly where the secondary image is used as a security device. For example, extra image elements may be added to the secondary image to disguise the primary images. For example, where the image elements are coloured pixels, randomly coloured pixels may be added to the secondary image.

The invention also extends to a security device produced by the foregoing method as well as documents or instruments incorporating security devices produced by the method.

Brief Description of the Drawings

A preferred embodiment of the invention will now be described in relation to the accompanying drawings in which:

Figure 1 shows a secondary image of a first example;

Figure 2 shows a mask suitable for use with both the first and second example;

Figure 3 shows how the mask of Figure 2 is used to reveal one of the primary images in Figure 1;

Figure 4 shows four original images which can be used as the basis of primary images;

Figure 5 shows the primary images produced from the images from Figure 4;

Figure 6 shows the primary images of Figure 5 combined into a secondary image;

Figure 7 shows the secondary image of Figure 6 wherein the white spaces are filled with random or pseudo random elements; and

Figure 8 shows an example of an alternative mask.

Description of the Preferred Embodiment

5 The preferred embodiment provides a method of
combining a plurality of primary images into a secondary
image in such a manner that the primary images can be
subsequently viewed by an observer. To view the images
the observer needs to have an appropriate mask which will
allow the images to be viewed. The method of the
10 preferred embodiment is particularly suitable for hiding
primary images within the secondary image. The secondary
image is preferably unintelligible so that it is not
readily apparent that the primary images are contained
within the secondary image. When the appropriate mask is
15 correctly oriented over a primary image, a primary image
can be perceived by an observer. By altering the relative
position of the observer and/or the mask and/or the
secondary image, each of the primary images can be viewed.
While the method of the preferred embodiment of the
20 invention is particularly suitable for providing a
security device, it can also be used in order to achieve a
novelty effect such as animation for example by combining
four related primary images into a secondary image and
causing each of them to be viewed in turn in order to
25 achieve an animation effect.

In the method of the preferred embodiment, this
effect is achieved by providing a mask which has a
plurality of regularly spaced viewing portions. A
30 plurality of primary images which consist of image
elements having the same spacing as the viewing portion
are also provided. The primary images are then combined
to form a secondary image. The images are combined in
such a manner that the image elements of the primary
35 images do not overlap. The viewing portions of the mask
are separated by image obscuring portions which obscure
the image elements of the other primary images when the

viewing portions are located over the image elements of one of the primary images.

In the preferred embodiment, a secondary image is
5 formed by interleaving and overlaying n primary images, where n is an integer. Each of the primary images to be included in the secondary image is formed by taking an original image and digitising it to produce a digitised original image consisting of a plurality of pixels. The
10 pixilated original images are then modified in order to allow them to be combined to create a secondary image.

Essentially, each of the original images must be modified by removing or adding sufficient pixels to
15 accommodate pixels of each of the other primary images in areas where the primary images are overlayed on one another. The remaining pixels are the "image elements" of the primary images. For example, an original image can be modified by laying the chosen mask over the top and
20 keeping only the pixels which fall within the viewing portions of the mask.

Any suitable technique may be used to generate primary images from original images. One such technique
25 is mechanical interleaving and overlaying. In this technique, each of the primary images is formed into a $p \times q$ matrix of pixels where p and q are integers. The physical dimensions of each pixel of each primary image is made to be the same. An interleaving algorithm is then
30 applied. An example of such an algorithm is to move each of the pixels in each of the original images so that it is separated from the next nearest pixel by $(n - 1)$ blank pixel spaces in one of the p -direction or the q -direction (that is, where there are n primary images to be combined
35 into the secondary images). The blank pixel spaces have the same physical dimension as the pixels of the original image. The original images have now been formed into

primary images which can be overlaid upon each other in such a way that the blank pixel spaces in each of the primary images becomes occupied by one of the other primary images. Thus, pixels belonging to any one of the
5 primary images do not overlap those belonging to any other primary image in any way.

A secondary image contained an $n \times n$ matrix of pixels none of which are blank and all of which originate
10 from an individual pixel of only one of the primary images is thus obtained.

An alternative technique of mathematical interleaving and overlaying may be used to form the
15 secondary image. Original images consisting of an array of multiple different symbols - e.g. the letters A, B or C or the like are created. Each of the original images is reconstituted into $p \times q$ matrix of pixels where p and q are integers. The physical size of each of the pixels, in
20 each of the original images is identical with those in the other original images. An algorithm is then applied to each original image to form the primary image. Such an algorithm can include the mathematical scaling down of a matrix to a non-integral fraction of its original form,
25 e.g. $.101p \times .101q$. In doing so a new pixel matrix is created for each original image in which the letter arrays employed in the primary images have now become mathematically interleaved and virtually unrecognisable. Pixel or groups of pixels in these images may appear to
30 have different grey-or intermediate colour tones as a result of the interleaving process. The primary images which have thus been created are now overlaid side by side with the other primary images in a repeating fashion to create the secondary image. The pixel matrix may be
35 equal to a larger than $n \times n$.

While the range of techniques can be used to

interleave and overlay images to form the secondary image, in all cases the techniques must be contrived so as to allow a mask having a plurality of viewing portions to render exclusively one of the primary images viewable.

5 The mask contains a plurality of viewing portions which are typically transparent or semi-transparent. The portions between the viewing portions act as image blocking portions.

10 An example of a mask which can be prepared is an $n \times n$ matrix of pixels in which every n th pixel in each direction is made transparent with all the remaining pixels made opaque. The physical dimensions of the viewing portions i.e. each n th pixel are made the same as
15 those in the secondary image which is to be viewed. When transposed upon the composite image the mask may be made to reveal selected pixels.

The original images which can be used to form
20 primary images or the primary images themselves can be graphical depictions of text, colours, portraits or images of people, animals, maps, geographical features, coats of arms, or other suitable images. The primary image may be repeated versions of a single image. Further, the primary
25 images may be created directly in a form suitable for combining into the secondary image.

The secondary image may be either readily
recognisable or unintelligible depending on the desired
30 application. Further, where it is desired to render the secondary image unintelligible, random or pseudo-random elements may be introduced into the secondary image to render it less intelligible.

35 A number of different techniques including printing, engraving, embossing, moulding, digital and photographic techniques can be used to produce the

secondary images and the decoding mask. Such techniques will be well known to persons skilled in the art.

Colours may be used in either the secondary image
5 or the mask in order to achieve colour-shifting effects in
which the movement of the mask over the composite image
produces sudden, noticeable changes in colour. This can
be achieved either by the use of translucent overlaying of
printed colours or by extinction of colours by an opaque
10 pixel. Alternatively, the human perception of side by
side combination of pixels of different colours may be
used to create an overall different colour. For example
as are done in the RGB and CMYK colour schemes. By
combining highly contrasted primary images into the
15 secondary image, flash illumination or multiple images may
be achieved. For example, primary images of brightly
highlighted messages or images are combined with poorly
highlighted primary images in the secondary image. When
a mask is moved relative to the face of the secondary
20 image, the brightly highlighted images are observed to
flash sequentially and noticeably.

The mask can be applied to one side of a piece of
transparent material with a secondary image applied to
25 another side. By moving the piece of transparent material
relevant to the observer, the different primary images can
be viewed. This is particularly useful in security
applications where it is desired to have the secondary
image which produces an animated effect.

30

Further, it is possible for the mask and the
secondary image to be carried by the same piece of
material in such a manner that the mask can be applied
over the secondary image by folding the material. For
35 example, the secondary image could be located at one end
of a bank note and the mask located at another end in such
a manner that when they are folded over they reveal the

secondary image to thereby provide verification of the validity of the banknote.

Different masks may be used in different applications. For example, for six primary images, where the image elements are pixels, one pixel in every group of 2×3 pixels should be a viewing portion. The invention is not restricted to rectangular arrays either - for example, the viewing portions could be hexagonal.

10

The present invention can be used to increase the security in anti-counterfeiting capabilities of items such as tickets, passports, licences, currency, and postal media. Other useful examples may include credit cards, photo identification cards, tickets, negotiable instruments, bank cheques, traveller's cheques, labels for clothing, drugs, alcohol, video tapes or the like, birth certificates, vehicle registration cards, land deed titles and visas.

20

Two examples of the present invention will now be described to further facilitate understanding of the invention.

25

Example 1

Example 1 shows a secondary image in which four primary images consisting of a grid of individual image elements in the form A, B, C and D have been overlaid upon one another in such a manner that they do not overlap.

30

Figure 2 shows a mask which has a plurality of viewing portions 5 separated by image obscuring portions 6. As shown in Figure 3, when the mask is properly located over the secondary image 1, all of the A elements are visible. Similarly, if the mask were to be displaced

35

to the right by one pixel all of the B elements would be visible.

Example 2

5

Figure 4 shows four original images. These images are prepared out of square elements having the same size as the mask shown in Figure 2. The square elements do not have to be the same size as the mask elements however, for worthwhile interleaving to occur the images must be much larger than the elements of the mask.

10
15
These elements are manipulated by taking 3 out of every 4 pixels to form the primary images shown in Figure 5.

20
These primary images are then each given a different colour and overlayed upon each other in such a manner that the image elements i.e. the pixels do not overlap as shown in Figure 6. It will be apparent in this Figure that the image 5(d) has been registered twice.

25
30
In Figure 7 the white background of the image has been obscured by placing further elements to fill all of the white spaces. It will thus be apparent that each of the primary images is effectively obscured within the image. However, when the mask is overlayed there is sufficient legibility to allow each of the primary images to be perceived separately.

35
Persons skilled in the art will appreciate that various modifications can be made to the present invention without departing from the scope of the invention. For example, masks using different shades or colours for the vertical and horizontal lines as shown in Figure 8 may be

used in order to improve contrast to allow the images to be better perceived. These and other modifications will be apparent to those skilled in the art.

5

Dated this 9th day of October 2002

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH
ORGANISATION

By their Patent Attorneys

10

GRIFFITH HACK

Fellows Institute of Patent and
Trade Mark Attorneys of Australia

A	B	A	B	A	B	A	B	A
D	C	D	C	D	C	D	C	D
A	B	A	B	A	B	A	B	A
D	C	D	C	D	C	D	C	D
A	B	A	B	A	B	A	B	A
D	C	D	C	D	C	D	C	D
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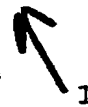


Figure 1

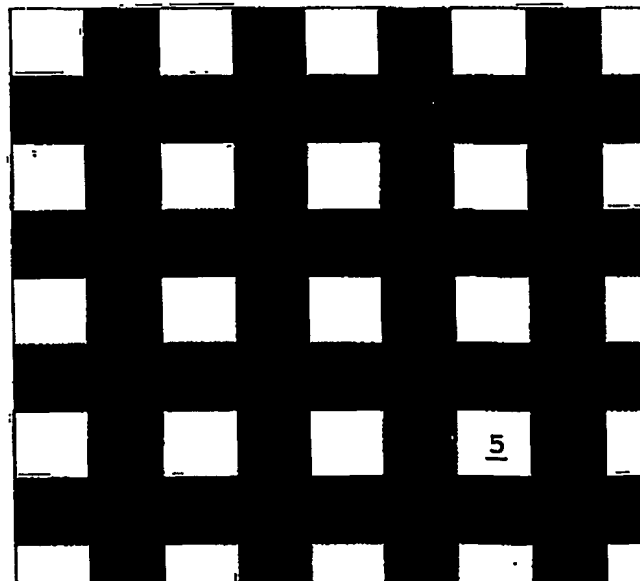


Figure 2

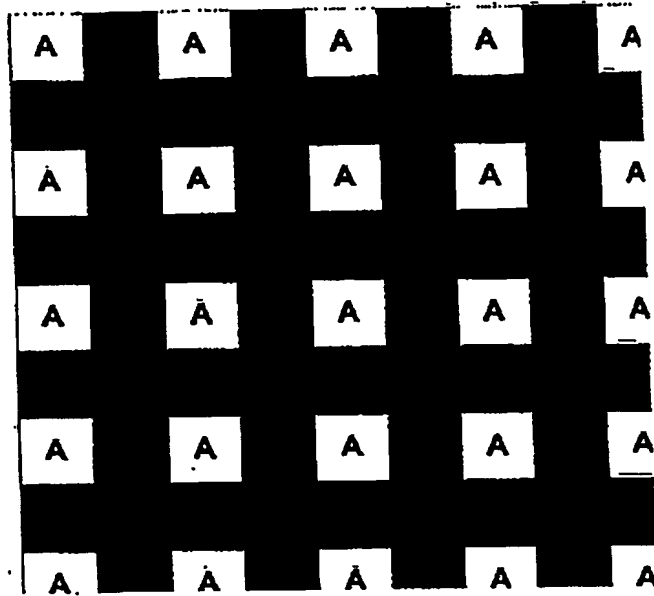


Figure 3

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CSIRO

(a)

LDMC

(b)

NPA

(c)

MS

(d)

Figure 4

CSIRO

(a)

LDN*

(b)

MPA

(c)

MS

(d)

Figure 5

Figure 6

Figure 6

Figure 7

Figure 7

Figure 8

Figure 8

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